

Post-It Fax Note	7671	Date	10/30	# of pages	6
To	Wes Watson	From	Jeff U Blane		
Co./Dept.	USACE	Co.			
Phone #			Phone #		
Fax #	502 582 5168	Fax #			

RADIOLOGICAL INVESTIGATION
Building 517
Formerly Marion Engineering District (MED)
U.S Army Depot

Marion, Ohio
October, 1998

Prepared by:
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Technical Assistance Provided by:
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Draft Report
10/26/98

Introduction

The Marion Engineering Depot (MED) was a 645-acre military base located in Marion County, Ohio. The site was used to support the storage and renovation of heavy construction machinery as well as the receipt, storage, and issuance of general supplies for the U.S. Army. The facility was constructed in 1942 and was deactivated in 1961. One facility at the Marion Engineering Depot that stored radioactive material was Building 517. This building is approximately 38 ft. by 70 ft. with 10.5-inch thick concrete walls and a brick exterior wall. There is one entrance to this building and there are no windows. The building stored metescopes, markers, and compasses containing radium. In 1958, the Army removed the radioactive material and attempted to decontaminate the building. In 1961, the Army returned to Building 517 and attempted a second decontamination.

The Ohio Department of Health, Bureau of Radiation Protection, conducted a radiological characterization¹ study of Building 517 in October 1997. This report concluded that the building interior exhibited generally elevated levels of both alpha and beta radiation. The report went on to conclude that the elevated beta activity discovered within the building was associated with the relatively long-lived, radon progeny, Pb-210 and its two direct progeny Bi-210 and Po-210. Thus, the contamination pathway was presumed to be from the Ra-226 stored in the building, which decayed to the radioactive gas Rn-222, which permeated into the walls of the building and quickly decayed to Pb-210. This same report recommended that the U.S. Army Corps of Engineers identify, by radionuclide, the source of the fixed alpha and beta activity detected inside Building 517 to substantiate this conclusion. This report provides the results of these additional samples.

Interior Survey Results

Three concrete chip samples were taken from the interior, and one concrete chip sample was taken from the exterior, of Building 517. The sample locations are depicted on a field drawing (attachment 1). The results for these samples are listed in the Table 1. The key activity result is associated with Pb-210 (the relatively long-lived, radon progeny believed to be the source of the elevated activity within the building).

Table 1
Concrete Chip Sample Results

Sample No.	Results in pCi/g			
	001	002	***003	004
^s cpm/126 cm ²	1800	1400	237	1166
Isotope	Results	Results	Results	Results
Bi-214	0.83	0.99	0.71	0.69
K-40	1.21	3.09	4.35	2.78
Pb-214	1.10	1.09	1.06	0.78
Ra-226	**	**	**	**
U-238	1.56	1.25	2.93	2.39
*Pb-210	43.7	136	0.69	30.6
****U-235	0.03	0.004	0.06	0.06
****U-238	1.07	0.56	1.29	1.06
****U-234	0.94	0.04	1.29	1.08
<ul style="list-style-type: none"> • \$ L2224 w/a 126 cm² alpha-beta scintillation detector; cpm should be increased by a factor of approximate 10 to estimate the dpm. • * Analysis by low energy gamma spectroscopy. • ** The Ra-226 activity level is set equal to the Pb-214 result. • *** This was a "clean" sample taken from the entryway leading into building 517. • **** Analysis by alpha spectroscopy. 				

¹ Radiological Characterization Study of Building 517 (Formerly Marion Engineering Depot). OHIO DEPARTMENT OF HEALTH, BUREAU OF RADIATION PROTECTION: October 30-31, 1997

Sample number 003 was taken from the concrete pad located in the entryway leading to the building. This sample was suspected to be clean because it did not exhibit elevated surface beta activity. Note that the Pb-210 activity level in the samples taken from within the building (001, 002, and 004) is much higher than the "clean" sample (003). The interior samples also exhibit high Pb-210 activity in the absence of the same activity levels in preceding decay chain radionuclides (Pb-214, Bi-214, and U-238). This is indicative of contamination existing in the absence of the source (parent) isotope - Rn-222 via decay from Ra-226. These results support the State of Ohio's original conclusion that the likely cause of the elevated beta activity within the building was due to contamination from the relatively long-lived radon progeny Pb-210 and its two direct descendants Bi-210 and Po-210. As a convenience, a portion of the U-238 decay chain has been included in this brief as Attachment 2.

Exterior Survey

Fourteen soil and three water samples were taken by Montgomery Watson from the areas surrounding Building 517. The results of these samples are presented in Table 2. All soil results appear to be in line with expected background activity for the Marion, Ohio area. Water results appear to be below criteria.

Table 2
Soil, Sediment, and Water Samples from the Land Area Surrounding Building 517

Soil and Sediment Results in pCi/g									
Sample ID	HA01 - SUR		HA01 - 2.5'		HA01 - S'		HA02 - SUR		
Analyte	Initial	20 Day	Initial	20 Day	Initial	20 Day	Initial	20 Day	
Bi-214	1.3	1.6	1.41	1.5	1.19	1.67	0.99	1.38	
K-40	17	17	18	18	19.6	21	15.5	16	
Pb-214	1.35	1.82	1.56	1.95	1.5	1.93	1.16	1.69	
Ra-226	**	**	**	**	**	**	**	**	
U-238	3.6	2.4	2.43	2.5	1.44	1.36	1.99	1.18	
Sample ID	HA02 - 2.5'		HA03-SUR		SUR01		SUR02		
Analyte	Initial	20 Day	Initial	20 Day	Initial	20 Day	Initial	20 Day	
Bi-214	1.08	1.33	0.78	0.99	0.68	0.96	0.67	1.02	
K-40	15.1	15.6	6.72	7.17	5.26	2.59	3.43	3.07	
Pb-214	1.11	1.59	0.87	1.31	0.79	0.93	0.82	1.02	
Ra-226	**	**	**	**	**	**	**	**	
U-238	2.49	2.30	1.2	0.13	-0.31	0.76	2.74	0.92	
Sample ID	SUR03		SUR04		SD-01		SD-02		
Analyte	Initial	20 Day	Initial	20 Day	Initial	20 Day	Initial	20 Day	
Bi-214	0.82	1.07	0.71	0.98	0.84	0.90	0.73	1.11	
K-40	4.53	2.85	2.84	2.5	9.43	9.55	10.4	9.18	
Pb-214	0.96	1.27	0.98	1.16	0.77	1.03	0.74	1.05	
Ra-226	**	**	**	**	**	**	**	**	
U-238	2.41	0.46	0.73	1.33	1.51	1.71	1.62	1.46	
Sample ID	SD-03		SD-04		NOTES				
Analyte	Initial	20 Day	Initial	20 Day	& Initial unequilibrated result \$ Equilibrated count (sample sealed for at least 20 days) ** Ra-226 assumed to be in equilibrium with Pb-214,				
Bi-214	1.21	1.55	0.74	0.87					
K-40	12.2	11.6	2.72	2.82					
Pb-214	1.15	1.59	0.94	1.13					
Ra-226	**	**	**	**					
U-238	1.26	4.03	-0.67	0.83					
Water Results are in pCi/l									
Sample ID	SW-01	SW-02	SW-03						
Analyte				Limits (NRC)					
Ra-226	0.309	0.203	0.119	60					
Tot-U		3.45	27.0	300					
Gross Alpha		19.9	253						
Gross Beta		21.3	163						

ATTACHMENT 1

BUILDING 517 SURVEY DRAWING AND
SAMPLE LOCATIONS

(DRAWING NOT TO
SCALE)

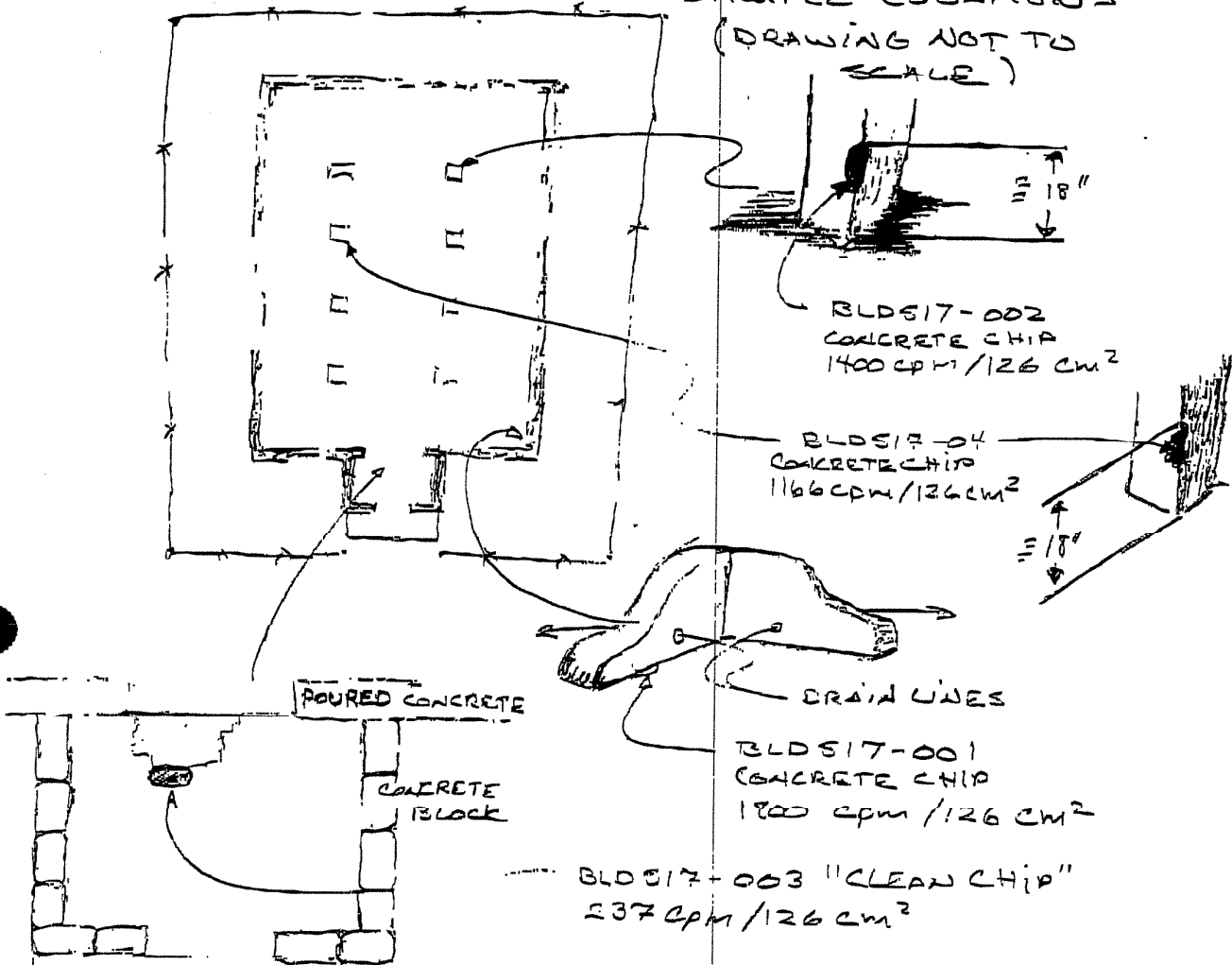


Table I-1
 Radium Decay Scheme

		Major Radiation Energies (MeV) and Intensities*					
Nuclide	Half-life	Alpha		beta		gamma	
		MeV	%	MeV	%	MeV	%
²²⁶ Ra ↓	1600 years	5.607 5.716 5.747	24.1 52.2 9.45			.144 .154 .269 .324 .338	3.3 5.6 13.6 3.9 2.8
²²² Rn ↓	3.822 days	6.425 6.53 6.819	7.4 12.1 80.3			.271 .402	9.9 6.6
²¹⁸ Po ↓	3.05 minutes	6.00	100	.33	.02	.837	.0011
²¹⁴ Pb ↓	26.8 minutes			.67 .73 1.03	48 42.3 6.3	.2419 .295 .332 .786	7.5 19.2 37.1 1.1
²¹⁴ Bi ↓	19.9 minutes	5.45 5.51	.012 .008	1.42 1.505 1.51 3.27	8.3 17.6 17.9 17.7	.609 1.12 1.763 2.204	56.1 15.0 15.9 3.0
²¹⁴ Po ↓	164 useconds	7.687	100			7997	.01
²¹⁰ Pb ↓	<u>22.3 years</u>	3.72	.000002	.016 .063	80 20	0.463	+
²¹⁰ Bi ↓	5.01 days	4.63 4.69	.00007 .00005	1.161	100		
²¹⁰ Po ↓	138.378 days	5.305	100			.802	.0011
²⁰⁶ Pb	Stable						

* This table presents the U-238 decay chain extending from Ra-226 to the stable isotope of Pb-210. Branching fractions (Ac-218 at 0.02%, Tl-210 at 0.21%, and Tl-206 at 0.00013%) have not been included in this table. A complete table may be reviewed in The Health Physics And Radiological Health Handbook (Ref. 2).

Low Energy
 beta
 Low Energy
 gamma
 Beta
 Alpha

OHIO DEPARTMENT OF HEALTH

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Post Office Box 118
Columbus, Ohio 43266-0118
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GEORGE V. VOINOVICH
Governor

PETER SOMANI, M.D., Ph.D.
Director of Health

26 January 1998

Mr. Wes Watson
Louisville Corps of Engineers
600 Dr. Martin Luther King Place
CELRL-ED-GER; Rm. 921
Louisville, Kentucky 40202

**RE: BUILDING 517 FINAL SURVEY REPORT BY OHIO DEPARTMENT OF
HEALTH/BUREAU OF RADIATION PROTECTION**

Dear Mr. ^{Wes}~~Watson~~:

Enclosed is a copy of the above referenced report. Please note that further actions are recommended by the department for follow up by the Army Corps of Engineers.

If you have any questions regarding this report or the recommended actions, please do not hesitate to contact me at 614-644-2719.

Respectfully,

Ruth H. Vandegrift

Ruth H. Vandegrift
Supervisor Decommissioning

RADIOLOGICAL CHARACTERIZATION STUDY
OF
BUILDING 517
(Formerly Marion Engineering Depot)

OCTOBER 30-31, 1997

OHIO DEPARTMENT OF HEALTH
BUREAU OF RADIATION PROTECTION

INTRODUCTION

The Marion Engineering Depot (MED) was a 645 acre military base located in Marion County, Ohio. The site was used to support the storage and renovation of heavy construction machinery, as well as the receipt, storage, and issuance of general supplies for the U.S. Army. The facility was constructed in 1942 and was deactivated in 1961. According to Mosher¹, radioactive material was stored at the Marion Engineering Depot and the Scioto Ordnance Plant.

One facility at the Marion Engineering Depot that stored radioactive material was Building 517. This building is approximately 38 ft. by 70 ft. with 10.5 inch thick concrete walls and a brick exterior wall. There is only one entrance to this building and there are no windows. The building stored metascopes, markers, and a few compasses containing radium. In 1958, the Army removed the radioactive material and attempted to decontaminate the building. In 1961, the Army returned to Building 517 and attempted a second decontamination.

In July 1997, citizens from the Marion community began noticing a higher incident of cancers among students who had graduated from the River Valley High School. The Ohio Department of Health and the Ohio EPA were requested to investigate the high incident of cancers among the former students of the River Valley High School. The Ohio Cancer Incidence Surveillance System, under the Ohio Department of Health, compared the River Valley High School students to other school-age populations and noted that the number of leukemias were much higher than expected. Other type of cancers did not show any significant difference between those that were expected and those that were observed in a similar population. It is important to note that leukemia can be produced from exposure to radiation, as well as, toxic chemicals. Based on the higher than expected number of leukemias, the OEPA and ODH initiated further environmental studies.

A radiological scoping survey of the River Valley Local School grounds detected a radium source buried just below the surface of the soils in front of the high school. The source measured 5.0 mR/Hr at the surface. Another radium source and radioactive rocks were also found inside the school. It appears that the radioactive sources detected inside the school were procured from an educational company, whereas the radium source found in the soils appear to be the product of the U.S. Army. These sources were properly removed by the Army Corp. Of Engineers in September 1997.

In light of this incident, the radiological surveillance was expanded to include a characterization study of Building 517, which was the property of the U.S. Army. Building 517 is not located on the River Valley School property. The Ohio Department of Health, Bureau of Radiation Protection was requested to conduct a radiological characterization study of Building 517.

¹. Mosher C.D., Mosher D.R., The Scioto Ordnance Plant and The Marion Engineer Depot of Marion, OH: A Profile After Forty Years, Wauseon, Ohio, Glanz Printing Co. 1987.

OBJECTIVE

Historical documents indicate that the primary radionuclide stored in Building 517 was Radium 226. At that time, the dose rate outside the 10 inch concrete wall measured 2 mR/Hr and soil samples taken approximately 10 feet from the building indicated beta-gamma activity of approximately 3000 disintegrations per second². According to a later report, that covered the decontamination of Building 517, stated that the most likely contamination would be daughter products of radon; namely Radium D (Pb-210), Radium E (Bi-210), and Radium F (Po-210) in equilibrium³.

Therefore, the objective of this characterization study was to determine if fixed and/or loose radioactive material is still present on the surface, and what the exposure rate are from this radioactive material in Building 517. In addition, the objective also included determining if Radium 226 and its daughters are present in the soils above ambient levels around the outside of Building 517.

METHODOLOGY

A radiological characterization study was conducted on Building 517 and the surrounding area on October 30th and October 31st. The study included surface scans, soil samples, direct radiation measurements, and smears. The surface scans included alpha, beta, and gamma measurements. These readings are recorded in counts per minute (cpm). The field instrument functionality check is documented in Attachment 1.

The facility was divided into a multitude of sections to allow for spatial identification. From wall to wall, the building was divided into sections as a function of the four pillars located inside Building 517. Thus, there were five (5) sections from the front entrance to the back wall, and there were three (3) sections from the left wall (looking into the building from the main entrance) to the right wall. From floor to ceiling, the area was divided into approximately three equal sections. A fold-out diagram is depicted in Attachment 2.

All measurements inside the building, with the exception of direct radiation measurements, were recorded for each section. Measurements taken on the ceiling were limited due to the availability of equipment to assist in reaching the ceiling.

² Report of Radiological Hygiene Survey No. 3328R81-59/60, from Adam J. Papalski, Colonel, MC Commanding to The Surgeon General, Department of the Army, Washington 25 D.C., dated June 1, 1959.

³ Report of Radiological Hygiene Special Survey No. 3892R63-61, from Adam J. Papalski, Colonel, MC Commanding to The Surgeon General, Attn: MEDPS-PO, Department of the Army Washington 25 D.C., dated April 26-27, 1961

Scan measurements taken inside the building were recorded two ways, 1) the highest average reading was recorded for each section, and 2) any measurement that was significantly larger than the highest average reading was also recorded in that section along with the highest average reading. Smears were taken in each section with the exception of the ceiling and columns.

Soil samples were collected in selected areas. Several soil samples were collected outside the building directly in front of the pipe discharge. Other soil samples were collected around the perimeter of the facility where areas may have been disturbed during operations of Building 517.

Background measurements were taken at Delaware State Park so that measurements from the Building 517 site can be compared to an unaffected area. Background scans and direct radiation measurements were taken inside a residential home to provide some perspective on measurements taken inside Building 517. These values are provided along with the values from Delaware State Park for comparative analysis. Blank smears were used with the active smears taken inside the building. The blank smears served as a background or as a control device.

DISCUSSION OF RESULTS

The radiological characterization study inside Building 517 resulted in 71 surface smears, 6 control smears, 8 direct radiation measurements, 78 gamma surface scans, 69 alpha surface scans, 126 beta surface scans, and 2 pipe samples. Measurements conducted outside of Building 517 resulted in 38 direct radiation measurements, 28 gamma surface scans, and 7 soil samples. The entire radiological characterization study compiled 433 measurements and/or samples.

Each circle or triangle in Attachment 2 represents the area or boundary of the survey. The triangle represents a more specific location or hot spot. Measurements performed at the triangle location represented the highest reading as reported in Attachment 3. The data, as depicted in Attachment 3, can be compared to Attachment 2 to determine the activity level at that location. Attachment 4 represents only locations (i.e., soil samples) and measurements for gamma activity, that were taken outside and around the perimeter of Building 517. The results are discussed below.

To provide a better orientation of Attachment 2, the following bullets provide a more detailed description:

Standing at the main entrance looking into Building 517

- o To the left, Location Id. 1 thru 15 are along the side wall
- o To the right, Location Id 16 thru 30 are along the side wall
- o To the rear wall, Location Id. 31 thru 39
- o Front wall, Location Id. 40 thru 48
- o Floor, Location Id. 49 thru 63
- o Location Id. 64 thru 71 (Triangles represent hot spot smears)
- o Ceiling, Location Id. 72-86

Alpha and beta surface scans detected higher than normal readings relative to background inside Building 517. Alpha surface scans ranged from 4 cpm to 200 cpm. A large number of the alpha surface scans ranged between 4-12 cpm which is comparable to background. Background alpha surface scans for outdoors and indoors were 1 cpm and 2 cpm, respectively. Some areas inside Building 517 had significant alpha activity as shown in Attachment 3.

The beta surface scans ranged from 20 cpm to 1100 cpm inside Building 517. The majority of the beta surface scans taken inside the building were consistently higher than background readings. Background beta surface scans taken indoors and outdoors were 30 cpm and 50 cpm, respectively. A visible watermark, approximately two feet above the floor, could be observed on the walls during the characterization study. The watermark appears to be a line of demarcation between higher beta surface scan readings and lower beta surface scan readings. In general, the higher beta scan readings were observed on the wall below the watermark, as well as the floor. It is suspected that the high beta readings are from the radium daughter products as discussed earlier in the Objective Section of this report.

Gamma surface scans inside Building 517 did not show any significant detection levels above background. Background readings indoors and outdoors ranged from 1500 cpm to 2600 cpm. The readings taken inside and outside Building 517 were consistent with background. The lack of gamma activity inside Building 517 would be consistent with the Army's findings in 1961 where the Radium D, Radium E, and Radium F exhibit little or no gamma activity.

All direct radiation measurements ranged from 4 uR/Hr to 7 uR/Hr. Lower readings were observed outside of Building 517. Direct radiation background measurements taken inside and outside were 4 uR/Hr and 7 uR/Hr, respectively. The low direct radiation measurements outside and inside Building 517 are indicative that the Army was successful in reducing the source of radiation inside Building 517.

Samples were collected from two pipes located in the front of the building. The samples were scraped from the pipe and collected in a plastic bag for gross alpha and gross beta measurements. The alpha and beta activity from the front pipe and side pipe were 310 dpm alpha and 1692 dpm beta, and 130 dpm alpha and 530 dpm beta, respectively. It appears that the pipes still show some activity levels from the decontamination efforts conducted by the U.S. Army in the 1950s and 1960s.

Soil samples collected outside and around Building 517 showed slightly elevated activity above background for Ra-226 in two areas. The concentration for Ra-226 ranged from 1.5 pCi/g to 3.5 pCi/g. Background concentrations for Ra-226 in soils, in Guernsey County, OH ranged from 0.6 pCi/g to 1.0 pCi/g. The background concentration for Ra-226 at the Mound Plant in Miamisburg, OH is 2.0 pCi/g. The Army Corp. of Engineers collected background soil samples around Marion County in 1997 prior to the excavation in front of the River Valley High School. A total of 10 background soil samples were collected and analyzed for Ra-226 and other radionuclides. Only one sample was reported to have a value greater than the minimum level of detection. The value was 8.7 pCi/g. The minimum detection was 4.0 pCi/g. It is difficult to determine at this time if the slightly higher levels of Ra-226 were the result of leakage from the equipment containing Ra-

226 in Building 517 or just abnormally higher background readings. The slightly elevated Ra-226 concentrations are considered borderline background at this time.

CONCLUSION

It can be concluded from this radiological characterization study that Building 517 has fixed alpha and beta contamination in excess of background. This activity appears to be embedded mostly in the floor and the first 2 feet below the watermark on each wall. Although the study does show that fixed alpha and beta surface activities are higher than background levels, it is suspected that the high readings are attributed to the daughter products of Ra-226.

The three suspect radionuclides that may account for the high alpha and beta activity inside Building 517 are Pb-210 (Radium D), Bi-210 (Radium E), and Po-210 (Radium F). The radionuclide Pb-210 is a long-lived daughter product of Radon 222 with a half-life of 19.4 years. This would explain the presence of this material in the concrete and possibly the soils today. The radionuclide Pb-210 produces a very low energy beta and gamma emissions. The gamma energy is 46.5 KeV and is produced only 4% of the decay process. The radionuclide Pb-210 decays to Bi-210. The Bi-210 decays to Po-210 producing an energetic beta ray and the radionuclide Po-210 which decays to Pb-206 (stable) by alpha emission. The Bi-210 and the Po-210 probably account for the large fraction of the detections.

It is hypothesized that the contamination detected from this survey did not occur during the storage of the Ra-226 equipment. But rather, the contamination was the result of the Radon gases emanating from the Ra-226. Thus the high level of Ra-226 used in the equipment produced excessive amounts of Radon into the building. The radon decayed to other radionuclides that have become fixed in the lower 2 foot section of the wall and the floor. Since the Pb-210, Bi-210 and Po-210 produce little or no gamma activity, this would account for the lack of gamma detections during the survey.

Two soil samples showed slightly higher than normal Ra-226 concentrations. The levels are extremely close to background levels and it is difficult to determine at this time if the Ra-226 concentrations are the result of past operations at Building 517 or just simply abnormal high background concentration.

RECOMMENDATION

It is recommended that Army Corp of Engineers identify, by radionuclide, the fixed alpha and beta activity detected inside Building 517. In addition, the Army Corp of Engineers should examine the soils directly beneath Building 517 to determine if any contaminants have penetrated the concrete floor via cracks or crevices during storage and/or during decontamination. The scope of this examination should also cover the surrounding soils around Building 517. Finally, the Army Corp of Engineers should also develop recommendations should further decontamination be necessary.

ATTACHMENT 1

OHIO DEPARTMENT OF HEALTH BUREAU OF RADIATION PROTECTION FIELD INSTRUMENTATION FUNCTIONALITY CHECK OCTOBER 30, 1997

<u>Instrument</u>	<u>Serial No.</u>	<u>Cal. Due Date</u>	<u>Battery</u>	<u>Source</u>	<u>Background</u>	
					<u>Park</u>	<u>Apartment</u>
1. Ludlum Model 19 Micro-R Meter	123914	07/17/98	Sat.	140 uR/Hr	7 uR/Hr	4 uR/Hr
2. Ludlum Model 18 w/Model 43-90	120973 125788	08/27/98	Sat.	NA	1 cpm	2 cpm
3. Ludlum Model 3 w/Model 44-9	16253 125090	04/03/98	Sat.	6000 cpm	50 cpm	30 cpm
4. Ludlum Model 12-4 w/Model 44-2	26215	06/25/98	Sat.	70000 cpm	2400 cpm	1500 cpm

NOTE: 1) Source Description A001 Co-60 0.80 uCi 6/29/93

2) All cables were observed as satisfactory

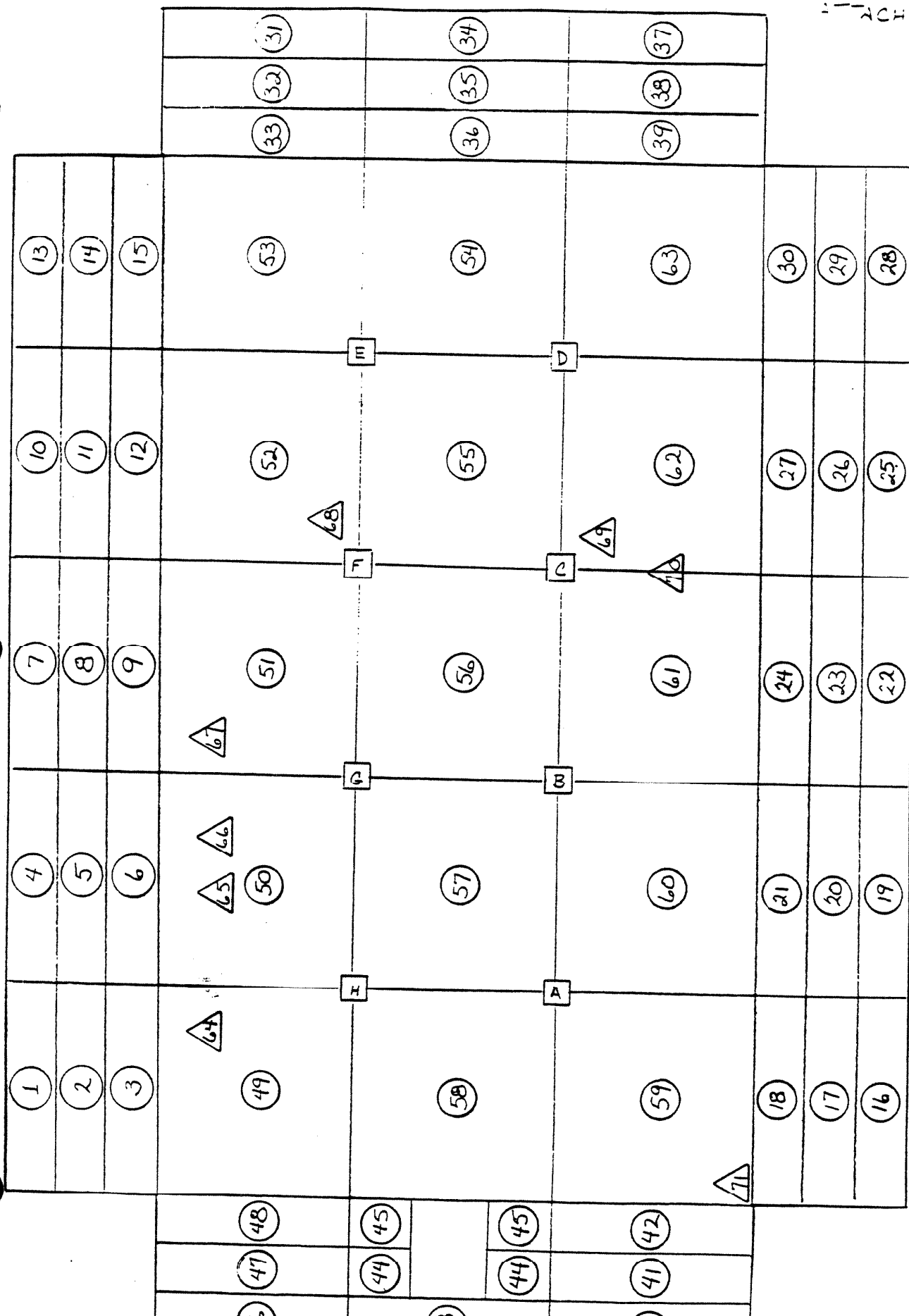
3) NA means Not Available

ATTACHMENT 1 (Cont.)

OHIO DEPARTMENT OF HEALTH
BUREAU OF RADIATION PROTECTION
FIELD INSTRUMENTATION FUNCTIONALITY CHECK
OCTOBER 31, 1997

<u>Instrument</u>	<u>Serial No.</u>	<u>Cal. Due Date</u>	<u>Battery</u>	<u>Source</u>	<u>Background</u>	
					<u>Park</u>	<u>Apartment</u>
1. Ludlum Model 19	123914	07/17/98	Sat.	140 uR/Hr	NA	NA
2. Ludlum Model 18 w/Model 43-90	120973 125788	08/27/98	Sat.	NA	NA	NA
3. Ludlum Model 3 w/Model 44-9	16253 125090	04/03/98	Sat.	6000 cpm	NA	NA
4. Ludlum Model 12-4 w/Model 44-2	26215	06/25/98	Sat	80000 cpm	NA	NA

NOTE: 1) Source Description A001 Co-60 0.80 uCi 06/29/93
2) All cables were observed as satisfactory
3) NA means Not Available



ATTACHMENT
(CONT)

	(76)		(81)		(86)
	E		D		
	(75)		(80)		(85)
	F		C		
	(74)		(79)		(84)
	G		B		
	(73)		(78)		(83)
	H		A		
	(72)		(77)		(82)

ATTACHMENT 3
SUMMARY OF DATA
BLDG 517 SURFACE AREA

Location Id.	Alpha		Beta		Gamma		Smear Activity		Direct Radiation
	Avg. (cpm)	High (cpm)	Avg. (cpm)	High (cpm)	Avg. (cpm)	High (cpm)	Alpha (dpm)	Beta (dpm)	
1	4	-	80	-	2400	-	0.80	2.82	-
2	6	-	80	-	2400	-	0.62	3.21	-
3	6	-	80	280	2400	-	0.49	1.83	-
4	4	-	80	-	2600	-	0.80	2.82	-
5	4	-	80	-	2300	-	0.49	2.43	-
6	12	60	100	160	2400	-	0.62	3.97	-
7	4	-	120	-	2400	-	0.71	2.43	-
8	6	-	120	280	2300	-	0.80	2.59	-
9	12	96	100	320	2400	-	0.31	2.89	-
10	4	-	100	-	2500	-	0.62	2.89	-
11	4	-	100	-	2400	-	1.02	2.52	-
12	6	60	120	-	2500	-	1.33	3.05	-
13	6	-	120	500	2400	-	0.49	2.59	-
14	4	-	180	-	2200	-	0.71	2.13	-
15	8	-	160	180	2400	-	0.31	3.35	-
16	4	-	100	-	2300	-	0.40	3.35	-
17	6	-	160	-	2200	-	0.62	2.66	-
18	6	60	140	400	2200	-	0.80	2.29	-
19	4	-	100	-	2400	-	0.19	2.13	-
20	4	-	160	-	2200	-	0.31	2.20	-
21	6	-	140	200	2100	-	0.49	2.89	-
22	4	-	120	-	2400	-	0.49	2.82	-
23	4	-	160	-	2300	-	0.49	2.89	-
24	6	-	180	300	2400	-	1.33	3.12	-
25	4	-	120	-	2500	-	0.93	2.82	-
26	6	-	160	-	2500	-	0.49	2.43	-
27	6	-	140	300	2400	-	1.54	3.51	-
28	4	-	120	-	2200	-	0.93	2.13	-
29	4	-	140	280	2400	-	0.40	2.59	-
30	6	-	160	-	2400	-	1.54	4.13	-
31	4	-	140	-	2400	-	0.71	2.66	-
32	4	-	120	-	2200	-	0.62	3.05	-
33	6	-	130	600	2300	-	0.71	3.67	-
34	4	-	80	-	2400	-	0.62	3.05	-
35	4	-	20	-	2400	-	0.40	2.36	-
36	6	60	80	180	2200	-	0.40	2.82	-
37	4	-	40	-	2300	-	0.49	2.06	-
38	4	-	40	-	2400	-	0.71	1.74	-
39	4	-	-	280	2400	-	0.49	2.52	-
40	4	-	-	300	2400	-	0.93	3.05	-
41	4	-	80	-	2200	-	0.40	2.66	-
42	-	132	80	600	2200	-	0.62	2.98	-
43	4	-	-	460	2400	-	0.62	2.36	-
44	4	-	80	380	2300	-	0.40	2.59	-
45	4	-	100	-	2200	-	0.62	2.66	-

SUMMARY OF DATA (CONT.)
BLDG 517 SURFACE AREA

Location Id.	Alpha		Beta		Gamma		Smear Activity		Direct Radiation
	Avg. (cpm)	High (cpm)	Avg. (cpm)	High (cpm)	Avg. (cpm)	High (cpm)	Alpha (dpm)	Beta (dpm)	
46	4	-	100	-	2400	-	1.02	3.21	-
47	4	-	80	-	2200	-	0.62	3.21	-
48	-	-	80	280	2200	-	0.49	2.89	-
49	25	-	400	800	2500	-	1.94	5.50	6
50	80	200	200	800	2600	-	1.02	3.28	-
51	25	-	300	500	2400	-	1.85	4.49	7
52	19	70	180	-	2400	-	1.11	4.72	-
53	20	-	200	-	2500	-	1.64	4.43	6
54	26	-	200	-	2600	-	2.25	5.41	7
55	21	-	200	-	2400	-	2.96	7.18	-
56	29	-	400	-	2500	-	3.27	8.39	6
57	22	-	200	-	2400	-	2.16	5.27	-
58	27	-	200	-	2400	-	0.49	3.67	-
59	20	-	-	500	2500	-	1.33	3.90	6
60	21	-	400	-	2400	-	1.64	4.65	-
61	25	-	400	600	2500	-	4.32	9.63	7
62	29	-	400	1100	2400	-	1.85	6.26	-
63	27	-	200	-	2400	-	2.04	4.72	6
64	-	-	-	-	-	-	2.50	5.73	-
65	-	-	-	-	-	-	10.06	15.13	-
66	-	-	-	-	-	-	5.65	10.91	-
67	-	-	-	-	-	-	1.42	5.41	-
68	-	-	-	-	-	-	4.01	10.62	-
69	-	-	-	-	-	-	3.49	13.53	-
70	-	-	-	-	-	-	1.42	3.44	-
71	-	-	-	-	-	-	1.85	6.49	-
72	-	-	300	-	2400	-	-	-	-
73	-	-	300	400	2200	-	-	-	-
74	-	-	300	-	2300	-	-	-	-
75	-	-	300	400	2200	-	-	-	-
76	-	-	300	-	2100	-	-	-	-
77	-	-	300	400	2300	-	-	-	-
78	-	-	300	-	2200	-	-	-	-
79	-	-	300	-	2400	-	-	-	-
80	-	-	300	-	2300	-	-	-	-
81	-	-	300	-	2300	-	-	-	-
82	-	-	300	-	2400	-	-	-	-
83	-	-	300	-	2200	-	-	-	-
84	-	-	300	-	2200	-	-	-	-
85	-	-	300	-	2500	-	-	-	-
86	-	-	300	-	2200	-	-	-	-

ATTACHMENT 3
SUMMARY OF DATA
MISCELLANEOUS SAMPLES

A. Support Columns

<u>Columns</u>	Count Rate (cpm)		
	<u>Upper Section</u>	<u>Middle Section</u>	<u>Lower Section</u>
A	200	200	300
B	200	200	300
C	200	200	300
D	200	200	400
E	200	200	300
F	200	200	300
G	200	200	200
H	200	200	300

B. Control Smears

<u>Smear Id.</u>	(dpm)	
	<u>Alpha</u>	<u>Beta</u>
1	0.19	2.20
2	0.40	2.66
3	0.40	1.74
4	0.49	2.20
5	0.31	2.06
6	0.31	2.20

C. Pipe Samples

<u>Sample Id.</u>	(dpm)	
	<u>Alpha</u>	<u>Beta</u>
Pipe-Front	309.80	1692.25
Pipe-Side	129.65	530.25

D. Soil Samples

<u>Soil Id.</u>	(pCi/Kg)			
	<u>K-40</u>	<u>Cs-137</u>	<u>Ra-226</u>	<u>Th-234</u>
1 (0-1 Ft.)	3659	309	1491	1238
1 (1-2 Ft.)	3385	252	1610	1790
2	4961	520	2360	1761
3	11070	448	3387	2384
5	3772	746	1990	1693
6	2480	1198	2069	1059
7	11840	91	3463	3625

ATTACHMENT 4

Measurements Outside Building 517

